

Technology Innovation Project



Project Brief

TIP 292: Advanced Heat Pump Water Heater Research

Context

The 6th Power Plan calls for a 50% penetration of heat pump water heaters in the PNWR by 2030. According to BPA, 40% of the region's residences have electric water heaters. The U.S. census says 40% of owner-occupied, single family homes in Idaho, Montana, Oregon and Washington equals approximately 1,300,000 homes. Of this number, approximately half are served by BPA customers; using the assumption that in areas served by these utilities the penetration of electric resistance space and water heating is higher, about 650,000 single-family, owner-occupied homes. In this sample alone, the 6th Plan is looking to put heat pump water heaters in 325,000 residences. For most utilities interested in this technology the one common denominator was to split the system—to eliminate the impact of the water heater on the conditioned space.

Description

Washington State University Energy Program (WSUEP), in partnership with Avista, Energy Trust of Oregon, Northwest Energy Efficiency Alliance (NEEA), Ravalli Electric Co-op and Tacoma Public Utilities, will research and demonstrate the performance of high-performance, next-generation heat pump water heaters in the laboratory and the three main heating climate zones of the Pacific Northwest.

The project will bring a split system, variable-speed-control dedicated heat pump water heater to the Pacific Northwest, where it will be subjected to the same lab and field tests as the integrated heat pump water heaters already marketed in the region. The research will take place over two years. In the first year the equipment will be imported and lab tested. In the second year it will be field tested in all three of the region's heating zones. The equipment under study in this proposal directly addresses the variable speed compressor option and solves the issue of increasing the space-heating load of residences served by the water heater. This technology promises to provide cost-effective high performance over a wide range of temperatures, representing a significant increase in heat pump water heater performance over existing technology.

The effort is a basic research project with potentially dynamic consequences. It is designed by utilities very interested in the technology. At least two of them have declared they do not support the installation of the current market heat pump water heaters in their service areas. They want to see how this technology works in their

climates before they commit to installations in their areas. Even utilities that serve the warmer part of the region are very interested in split systems. And they want to participate in field tests on their grids.

The specific tasks involved in this project are as follows:

1. Select and import five split system heat pump water heaters.
2. Conduct lab tests to national and regional protocols.
3. Select field sites, obtain permits or waivers, and execute homeowner agreements.
4. Conduct field tests to regional protocols, analyze and report.

Why It Matters

It is crucial to not delay the introduction of what may be an important technology for heat pump water heaters. The PNWR stands at a crossroads. It is currently heavily invested in integrated heat pump water heater technology with single speed compressors, limited to a rated Coefficient of Performance (COP) of 2 to 2.5. WSUEP proposes to introduce a variable speed split system with a rated COP greater than 3. The probability of success is high with the partnership that has come together for this project.

Assuming an average annual hot water load of 3,300 kWh and an average annual COP of 3, the annual savings would be approximately 2,200 kWh. This system does not add to the space heat load of the home to which it supplies hot water. Over the 18-year build out, at the 6th Power Plan discount rate of 5%, with an assumed retail energy cost of 6 cents per kWh, the total present retail value of the cumulative savings would be almost \$40 million.

Goals and Objectives

This is a low-cost research project with potentially significant ramifications. It will bring a split system dedicated heat pump water heater to the Pacific Northwest and subject it to all the tests that current integrated systems have undergone. This will allow necessary comparisons to be made.

WSUEP's long-term strategy is to find a supplier for this project also interested in developing a cost-effective carbon dioxide refrigerant heat pump water heater, part of the qualifications explored when WSUEP and its Project Advisory Task Force choose a manufacturer.

TIP 292: Advanced Heat Pump Water Heater Research

Project Start Date: October 1, 2012

Project End Date: September 30, 2015

Funding

Total Project Cost: \$880,000

BPA Share: \$440,000

External Share: \$440,000

BPA FY2013 Budget: \$140,000

Reports & References (Optional)

Links (Optional)

For More Information Contact:

BPA Project Manager:

Kacie Bedney, kcbedney@bpa.gov

Participating Organizations

Washington State University Energy Program

